

## Resources & Environment



### Environmental Regulation & Location of Hog Production

Environmental regulation, and the added costs generally associated with compliance, are considerations often factored into the choice of a business location. It has been hypothesized that geographic variation in environmental regulations and enforcement can induce a migration of industries across state or country boundaries to “pollution havens” where compliance costs associated with environmental regulations are lower.

Analysis of how environmental regulation and enforcement at the state and county level (instead of at the Federal level) have affected location decisions by industrial agriculture can provide some insight into whether the pollution haven phenomenon applies to agriculture. In addition, it may help explain why efforts to regain some national control of the regulatory process by implementing national standards have engendered negative reactions. For example, local pressures could cause Congress to balk at appropriating funds for enforcement if the U.S. Environmental Protection Agency (EPA) tightens existing Federal water quality laws through regulations proposed for confined animal feeding operations.

Study of whether environmental regulation causes agricultural businesses to relocate may also shed some light on effects of environmental regulation in the international arena. Proposals to harmonize (reconcile) environmental standards across international boundaries add to the urgency of the question because of concerns raised that trade liberalization could induce increased investment in agricultural production in countries with lower environmental standards.

Two emerging issues addressed by USDA’s Economic Research Service (ERS) are: 1) the relationship between stringency of regulation and location of animal production, and 2) environmental implications of confined animal production (see article on page 12). This article discusses some of the reasons for heightened interest in the links between stringency of environmental regulation and location of the U.S. swine industry. ERS analyzes the impacts of environmental regulation on the location of animal production using information from studies presented at an ERS-Farm Foundation workshop on industry location analysis, as well as extensive review of recently published analyses.

#### *Hog Industry Relocation & Concentration*

Regulations to protect the environment have historically addressed concerns about environmental pollution from identifiable “point” sources in the manufacturing sector. But advances in understanding the potentially damaging effects of pollutants in runoff from agricultural production sites—i.e., point- and nonpoint-source pollution—have led to efforts to extend environmental regulation to agricultural activities as well.

A report by the EPA published in the *Federal Register* concludes that agriculture is the leading source of pollutants in assessed rivers and streams, contributing to 59 percent of reported water quality problems and affecting about 170,000 river miles of the assessed waterways. Unlike manufacturing, however, it is difficult to correlate damage to the environment with production activities at a specific farm or animal production operation. Nevertheless, concern about the environmental effects of agricultural production is becoming more widespread, exacerbated by the proliferation of large animal production facilities, particularly those concentrated in certain geographic areas.

Recently released data from the 1997 Census of Agriculture indicate the number of hog operations in the U.S. has decreased by half in 10 years, but total inventory has remained relatively constant as smaller operations exit and the average operation gets larger. Swine production is more mobile than other livestock sectors. Hogs can be transported more easily than other livestock, and are not tied to the land, as are cattle. Also, contract operations account for a large share of hog production, and when a contractor moves or expands into a new region, new contracts can be negotiated in the new location.

Hog production has expanded in recent years in areas in the South and in nontraditional areas of the West, and a number of counties that were only minimally involved in the hog industry as of 1992 now have significant numbers of hogs. This has prompted speculation that large operations moved to those areas because of possibly less stringent environmental regulations.

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Some high-profile environmental accidents have pointed to the risk potential of concentrated animal production. For example, the problem of leakage from large waste lagoons attracted public attention when millions of gallons of manure overflowed in North Carolina in the aftermath of Hurricane Floyd in 1999.

Implementation of environmental regulations can impose compliance costs on producers and reduce profits. Estimates from one study of hog producers in the U.S. and the European Union (EU) put U.S. waste management costs at \$0.40 to \$3.20 per hog, which represents 1-8 percent of total hog production costs for the operations studied, higher than in previous years because of added costs of regulatory compliance. Because of the stringency of the EU Nitrate Directive, estimated costs of compliance for hog operations there are higher than in the U.S., raising concerns about EU export competitiveness.

Producers may respond to existing or impending costs of regulation by exiting the industry or by changing the scale and/or location of production. Moving to a different state or country might mitigate or bypass the costs of local or domestic environmental regulations altogether, but adding new capacity at the same site might enable economies of scale that offset additional costs of compliance.

However, responses that promote larger hog operations create potential for greater volumes of hog manure to adversely affect water quality in a local area.

State-level estimates in December 1999 indicate that 17 states account for the vast majority of very large hog and pig operations (inventory exceeding 5,000 head). North Carolina, Iowa, and Minnesota stand out in number of very large operations. Perhaps even more significantly, however, very large operations in Colorado, Oklahoma, and Texas, while much fewer in number, account for almost all hog production in those states.

EPA requires operations with an inventory of more than 1,000 *animal units* to have National Pollution Discharge Elimination System (NPDES) permits for manure storage or to demonstrate that there is no runoff from the farm (EPA defines 1,000 animal units for hogs as 2,500 head).

**Many of 100 Top-Ranked Hog Counties Moved Up Substantially During 1992-97**

Rank		County	State	1997 inventory 1,000 head
1997	1992			
1	1	Duplin	NC	2,034
2	2	Sampson	NC	1,776
3	797	Texas	OK	907
4	3	Sioux	IA	762
5	28	Bladen	NC	759
6	736	Sullivan	MO	d
30	1,904	Beaver	UT	263
33	366	Columbus	NC	258
35	401	Jones	NC	253
48	776	Yuma	CO	206
49	1,361	Dallam	TX	d
59	330	Ringgold	IA	181
64	1,888	Morton	KS	d
67	1,490	Woodward	OK	d
71	315	Edgecombe	NC	169
97	347	Philips	CO	d
98	406	Gentry	MO	139
100	33	Johnson	IA	138

Selected counties ranked by inventory. Annual inventory includes breeding and marketing inventory.

d = Withheld to avoid disclosing data for individual farms.

Source: Census of Agriculture.

Economic Research Service, USDA

However, interpretation of the regulation varies from state to state, and many states pursue enforcement only in response to citizen complaints. According to EPA, a very small proportion of operations with more than 2,500 hogs had acquired the appropriate manure storage permits.

Type of ownership of hog producing and packing operations appears to play a role in the locational response to environmental regulation. Individual producers with family-owned operations are not likely to move operations to different locations as a result of regulatory changes. Instead, they are more likely to continue operating, perhaps at a different scale, or shut down the enterprise. In addition, as the hog industry moves toward more production under contract, contractees who grow hogs for larger operations may have limited ability to adapt if they incur additional costs from regulations and get no financial assistance from contractors. In the past, production contracts allowed for specific returns on the finished product, but have left the costs of manure management to the producer.

Most large corporate production companies already operate facilities in multiple

states, easing the shift of production between states in response to changes in business conditions. For example, Purina has production facilities in seven states. Similarly, many top packers also operate multiple plants across states, so the economic benefits of clustering production and packing facilities together could be maintained even as production capacity shifts. Given advances in litter production technology (i.e., more litters per sow and more pigs per litter), businesses that own over 100,000 sows could produce 2 million pigs a year for slaughter, promising large potential savings on transportation costs from clustering facilities in fewer, more hospitable locations.

Analyses of business location decisions often focus on four factors: natural endowments, economic costs, business climate, and public policies (including environmental regulation). International location studies based on interviews with business executives have rated political stability, taxes, exchange rate convertibility, and repatriation of profits as key factors in foreign investment decisions. Environmental regulations were ranked much lower on the list of considerations.

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Studies of the hog industry in particular indicate that significant variables (factors) in location decisions for hog farms are precipitation, existing percentage of large hog farms in the state, feed costs, and density of production. Evidence indicates that the recent shift in hog operations to western states (primarily Colorado, Oklahoma, and Texas) resulted in part from savings in transportation costs, because the move puts exportable products one day closer to the Japanese market compared with producers in the Midwest and South. In addition, the West offers a relatively disease-free environment for raising animals. Nevertheless, production shifts to these more sparsely populated regions highlights the relationship between location, concentration, and environmental impact.

As animal operations become larger, more states are looking at ways to protect environmental quality from excess animal waste. Large confined animal operations can present major problems at the local level. Part of the potential environmental impact lies in the assimilative capacity of soil and crops to prevent nitrogen and phosphorous from reaching local surface water and groundwater resources. The National Pollution Discharge Elimination System point-source permit system—part of the Clean Water Act—addresses on-site storage of manure, but not disposal.

### Regulatory Stringency & Enforcement Vary

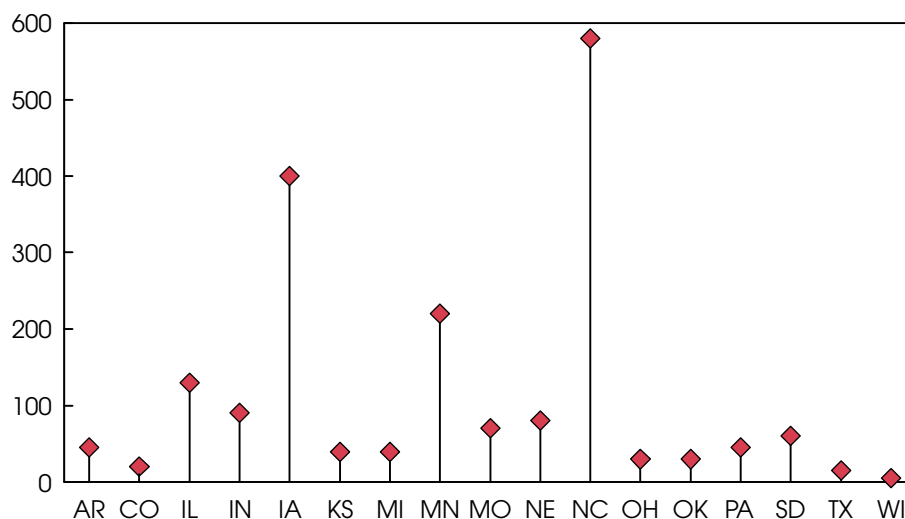
States' policies regulating nonpoint-source pollution may vary because of

- the design of Federal water policy laws,
- characteristics of the nonpoint-source pollution, and
- characteristics of the states that have to deal with water quality issues.

*Federal water quality laws* reflect both the nation's desire to address existing environmental problems, and the conviction that states should have sufficient authority and flexibility to design and implement their own environmental laws. States also have the option to provide funding for voluntary programs to address the environmental needs of local areas.

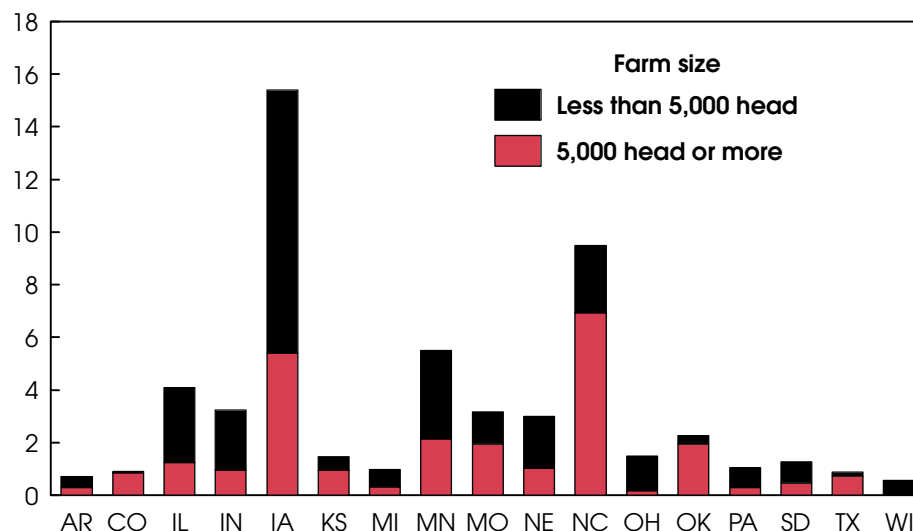
### North Carolina Leads in Number of Large Hog Farms...

Number of large farms



### ...and in Hog Inventory on Large Farms

Million head



Inventory on large operations is at least 5,000 head annually, and includes breeding and marketing inventory.

Source: National Agricultural Statistics Service, USDA, *Hogs and Pigs*, December 1999.

Economic Research Service, USDA

When the Clean Water Act was passed in 1972, point sources were seen as the primary culprits in water and air pollution, so the discharge permit program was designed to limit emissions by known polluters. Nonpoint-source pollution was considered a lesser problem that could be left to the states to manage. In fact, there

is some benefit to relegating nonpoint-source pollution law to state or local level jurisdictions that are closer to the problem—e.g., more detailed knowledge of the problem and more sensitivity to impacts of the solution.

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A possible drawback to locally developed policies is that local jurisdictions sometimes have insufficient resources to develop and enforce regulatory programs. In addition, regulations at a local level may not effectively address transboundary issues, which may lead to an increase in frequency of pollutant flows from one jurisdiction to another. If there is a solution to a transboundary issue, it often comes from the coordination of activities of local jurisdictions by a Federal government agency like the EPA.

*Nonpoint-source pollution* is characterized by difficulty in observing runoff and by natural variability of pollution flows with changes in weather, so linking observations of particular management practices associated with confined hog feeding operations to changes in water quality is problematic. And predicting how changes in management practices will affect water quality presents challenges.

*Differences within states* in farming practices, land forms, climate, and hydrologic characteristics is another complication in policy design. Variation in the environmental impact of agricultural production can occur even within relatively small geographic areas. Transboundary effects, uncertainty in measuring actual water quality damage, and time lags in the movement of a pollutant into a water system also factor into policy design.

Forty-four states have passed laws or instituted programs that either protect water quality directly by curbing point-source pollution, or protect it indirectly by regulating an agricultural production practice associated with generation of non-point-source pollution. Some state laws are follow-ons to Federal clean water laws, while others respond to chronic local problems such as nitrates or pesticides in groundwater. To help improve water quality, states may institute controls on inputs or practices and land use, offer economic incentives, and provide for educational programs.

Difficulty in measuring the stringency of environmental regulations is a limitation for analysis of whether state environmental regulations affect the location or expansion decisions of hog producers. Environmental indices that rank states on

level of environmental protection are of limited use for agricultural analysis, particularly indices that predate rapid growth in an industry like swine production. The components underlying the indices do not relate specifically to agricultural industries or to environmental problems spawned by concentration in livestock production. For example, one index assigns states to four categories of environmental protection—environmentally progressive, struggler, delayer, or environmentally regressive—in 1990 and 1994. While this ranking highlights the potential for states to move up or down in environmental protection, it does not take into account environmental problems that did not even exist a few years ago. Recent research has started improving these indexes.

Specificity can add stringency to regulation. For example, states may develop regulations specific to an industry to give more regulatory attention to a perceived problem. However, specific regulation can also reflect efforts to stave off even more stringent regulation—known as a “no more stringent than” law. By enacting a legislative prohibition on future, more stringent, environmental regulations, states may be seeking to encourage facilities to locate there.

Regulations that include reporting requirements and that indicate some accountability for firms’ actions have greater stringency than those that simply recommend best management practices. The number of permit bars or blocks that preclude violators from obtaining new permits until problems have been addressed is a better indicator of regulatory stringency than the number of penalties, since penalties may or may not be imposed for environmental infractions due to lack of enforcement capability or funding.

Another indicator of stringency is sufficient resources and staff allocated to enforcement by state agencies. Rational enforcement agents should be optimizing some weighted function of their agency’s political interests and the general social welfare. Level of enforcement may not significantly affect firms’ locational response to regulatory restrictions if expected costs of noncompliance are less than expected costs of compliance. In fact, very few operations in any state have

been penalized in the past, and the penalties were generally small compared with overall costs of the operation.

Even with Federal laws like the Clean Water Act and the Clean Air Act, enforcement is normally delegated to state agencies. However, government agencies don’t usually take on the task of regulation in advance of a problem, so regulation generally lags the appearance of environmental damage. Areas that develop the most stringent regulations will tend to be those that already have environmental problems, that have the most production with potential to cause environmental problems, or that have production close to population centers where citizens are concerned about potential problems.

No matter how stringent, sometimes state laws are ineffective because they are applied unevenly. For example, a study commissioned by the Indiana legislature reveals that many of the state’s environmental regulations only apply to new operations, because older operations are “grandfathered in”—i.e., not subject to the new rules. However, grandfathering may be politically necessary to get environmental legislation passed.

### ***Does Environmental Regulation Influence Location?***

Conjecture is that animal industries tend to move to areas with a lax environmental regulatory structure. Lax structure can mean either no effort to enforce, or lack of institutional capabilities or financial resources to enforce. It may also mean an absence of perceived need for environmental regulation or enforcement. Locational shifts may involve moves between geographic areas, or clustering within a given area.

Clustering may occur in areas where existing climatic and geologic factors such as slope or rainfall make it less costly to comply with standardized regulations. For example, protecting a lagoon from overflowing is easier and is lower cost on land that is not a floodplain or where the distribution of rainfall is not problematic. Clustering has a cumulative effect in lowering costs, with processing facilities drawing in more production facilities that may in turn draw in more



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processing, allied agribusiness, and input suppliers.

Studies examined indicate that hog operations locate wherever they can function on a large scale and realize unit-cost savings. Compliance costs for environmental regulations were only a minor consideration in the past, but this could change with likely stricter future regulations governing larger producers. Mitigating environmental problems in areas of expanding hog production can nevertheless be consistent with profitable operations.

Producers can lower compliance costs by altering practices. For example, modifying the cropping system can increase the capacity of farmland to absorb nitrates and phosphorous from manure, and feed supplementation with phytase reduces the amount of phosphorous excreted by hogs. Since much of the best technology for dealing with pollution from hogs is expensive, clustering many large operations in an area can make use of the technology more cost-effective. For example, a custom applicator for manure facilitates injecting manure into the soil locally rather than transporting it long distances. Joint ownership and use of such machines increases cost-effectiveness and reduces compliance costs for all.

One somewhat surprising finding is that stringent regulation—which doesn't necessarily imply stringent enforcement—may actually attract industries to states. Since specificity in regulations makes the rules clear for industries planning for future operations, the uncertainty of having to deal with regulations as they develop is reduced. However, the more a state spends on environmental *enforcement*, the less likely a given firm will locate in that state. Differences in level of enforcement among nearby states, especially if competitors already operate in the area, may also affect location decisions. For example, new operations might be disadvantaged if they incur costs not imposed on existing businesses.

Additional research is needed to estimate the potential impacts of new state and Federal water quality regulations on the animal production sector. For example, compliance costs for the Unified National Strategy for Animal Feeding Operations—an initiative announced by USDA and EPA—will be one subject for future research. Research in the future also will explore the relationship between type, size, and location of operation, and unit costs for compliance with particular environmental laws.

Location decisions, while important at the state level, also have an international context, with concerns about large production companies shifting investment outside the U.S. Production in other countries would still face variations in environmental regulations. The European Union experience with its Nitrate Directive is instructive, demonstrating that limiting producers' options with strict regulation of nitrate levels in an area with a limited land base has the potential to greatly reduce the scale and to influence the location of animal production. For example, an EU hog producer has built production facilities in five U.S. states, in part because of EU environmental constraints.

Harmonization of environmental standards across international boundaries is a contentious topic in World Trade Organization (WTO) discussions, because of possible effects on the location of agricultural businesses, as well as geographic dispersion of the emissions. If uniform environmental regulations were to raise costs of production in some countries so high that they could no longer be competitive in export markets, producers in those countries would likely appeal for an exemption, and some countries might be willing to enhance their export competitiveness at the expense of the environment.

With its abundant land base, the U.S. is generally better able to accommodate compliance with environmental regulations. However, certain localities within

the U.S.—e.g., where manure disposal is a problem (see map on page 17)—could have difficulty complying with stricter environmental regulations. **AO**

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### September Releases—USDA's Agricultural Statistics Board

The following reports are issued electronically at 3 p.m. (ET) unless otherwise indicated.

#### September

- 1 Dairy Products Prices (8:30 am)  
Dairy Products
- 5 Egg Products  
Poultry Slaughter  
Crop Progress (4 pm)
- 6 Weather - Crop Summary  
Broiler Hatchery
- 8 Dairy Products Prices (8:30 am)  
Vegetables
- 11 Crop Progress (4 pm)
- 12 Cotton Ginnings (8:30 am)  
Crop Production (8:30 am)  
Weather - Crop Summary
- 13 Broiler Hatchery  
Turkey Hatchery
- 15 Dairy Products Prices (8:30 am)  
Cattle on Feed  
Milk Production
- 18 Hop Stocks  
Crop Progress (4 pm)
- 19 Weather - Crop Summary
- 20 Broiler Hatchery  
Cold Storage
- 21 Citrus Fruits  
Potatoes
- 22 Dairy Products Prices (8:30 am)  
Catfish Processing  
Chickens & Eggs  
Hogs & Pigs  
Livestock Slaughter  
NASS Facts Newsletter (4 pm)
- 25 Cotton Ginnings (8:30 am)  
Crop Progress (4 pm)
- 26 Weather - Crop Summary
- 27 Broiler Hatchery
- 28 Agricultural Prices  
Peanut Stocks & Processing
- 29 Dairy Products Prices (8:30 am)  
Grain Stocks (8:30 am)  
Small Grains Summary (8:30 am)